AME5140 Evaluation Board User Guide

1. General Descriptions

The AME5140 is a non-synchronous step-up DC/DC converter with integrated N-channel Power MOS. This device is a current-mode converter operating at fixed frequency of 1.6MHz. It's available in SOT-25, DFN-8C and MSOP-8 packages; it can support standard step-up application and provides a backlight solution with minimal external components as well.

2. Features

- Input voltage: 2.7V to 5.5V
- Oscillation frequency: 1.6MHz
- Current limit and Enable function
- Uses Tiny Capacitors and Inductors
- Output voltage: Vin to 30V
- Switching current up t0 1.8A
- Low Shutdown Current (<1uA)
- Thermal shutdown function

3. Applications

- White LED Current Source
- Portable Phones and Games
- Local Boost Regulator
- PDA's and Palm-Top Computers
- Digital Cameras

4. Evaluation Board Schematic

(4.1) AME5140 Typical Schematic

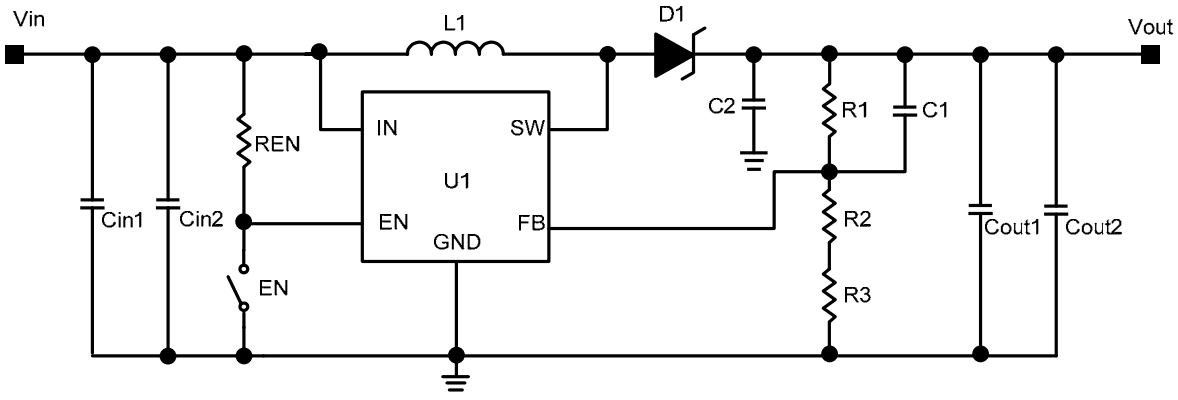

Figure 1

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(4.2) AME5140 Typical Schematic for 12V Application

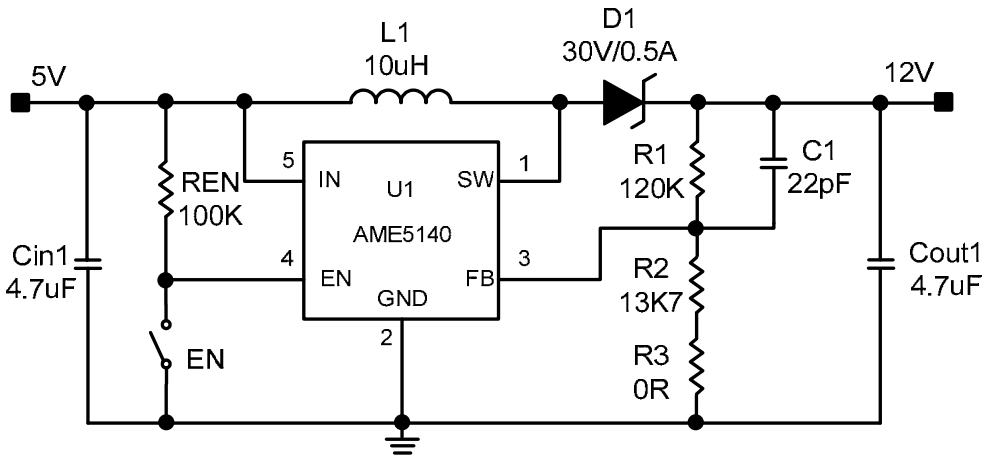

Figure 2

5. Bill of Materials

BOM for Item (4.2)

Component	Q'ty	Value	Description	Part No.	Manufacturer	Package
Cin1	1	4.7uF/6.3V	Ceramic Capacitor	1206B475K6R3C	WALSIN	1206
Cout1	1	4.7uF/16V	Ceramic Capacitor	1206B475K160C	WALSIN	1206
C1	1	22pF/16V	Ceramic Capacitor	0805B220K160C	WALSIN	0805
R1	1	120KΩ	Chip Resistor	RM10FTN1203	TA-I	0805
R2	1	13.7KΩ	Chip Resistor	RM10FTN1372	TA-I	0805
R3	1	0Ω	Chip Resistor	RM10JTN0	TA-I	0805
REN	1	100KΩ	Chip Resistor	RM10JTN104	TA-I	0805
L1	1	10uH	Inductor	SD52-10R0-R	COOPER	SD52
D1	1	30V/0.5A	Schottky Diode	RB550SS-30	ROHM	KMD2
U1	1	-	1.6MHz, 30V Boost Converter	AME5140AEEVADJZ	AME	SOT-25
PCB	1	-	Blank PCB	TM080104 Rev.D	AME	-
Vin,Vout GND,GND	4	4	-	Copper Pillar	-	-
EN	1	-	Switch	TS-006S-5-190g	HSUAN YI	-
-	4	-	Plastic Screw	S-306	PINGOOD	-
-	4	-	Spacer Support	H-6	PINGOOD	-

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6. Operating Instructions

(6.1) Connect Vin to the positive point of DC power supply and GND to supply ground.

(6.2) Connect Vout to the positive point of E-load and GND to supply ground or parallel an appropriate resistor to pull up the loading.

(6.3) Importing a logic signal to EN pin will enable the AME5140. Logic high (V_{EN}>2V) switches on AME5140, logic low puts it into low current shutdown mode.

7. Application Information

(7.1) Setting Output Voltage & Current

(7.1.1) Output Voltage

The regulated output voltage is set by an external resistor divider (R1 and R2 in Figure 2.) from the output to the V_{FB} pin and is determined by:

$$V_{OUT} = V_{FB} \times (1 + \frac{R_1}{R_2})$$; Where V_{FB} = 1.23V for AME5140.

(7.1.2) Duty Cycle & Output Current

According to input and output voltage to calculate duty cycle and switching frequency. Selecting feasible inductance can calculate output current by following equations.

$$D = \frac{V_{OUT} + V_{DIODE} - V_{IN}}{V_{OUT} + V_{DIODE} - V_{SW}}$$

$$V_{SW} = I_{CL(Typ)} \times R_{DS(ON)(Max)}$$

$$I_{LOAD(\max)} = (1 - D) \times \{I_{CL(\min)} - \frac{D \times (V_{IN} - V_{SW})}{2fL}\}$$

Where:

V_{IN} is input voltage

V_{OUT} is output voltage

V_{DIODE} is the forward voltage of Schottky Diode

V_{SW} is (“switch current limit” times “switch on-Resistance”); See the datasheet to have

L is the inductance

f is the switching frequency

$I_{LOAD(max)}$ means the maximum ability of output driving

(7.2) Capacitor Selection

4.7uF input capacitor can reduce input ripple. For better voltage stability, to increase the input capacitor value or using LC filter is feasible.

4.7uF output capacitor is sufficient to reduce output voltage ripple. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider voltage and temperature ranges.

22pF capacitor parallel with feedback resistor R1 is for compensation the output stability when pulling up heavy loading. 10pF~100pF capacitance is common selection.

(7.3) Inductor Value Calculation

A larger value of inductor will reduce the peak inductor current, resulting in smaller input ripple current, higher efficiency and reducing stress on the internal MOSFET. Low DCR inductor also can increase average efficiency. Calculate the required inductance by the equation below.

The recommended value of inductor for AME5140 application is 2.2uH ~ 10uH.

$$L \geq \frac{D \times \left(V_{IN} - V_{SW}\right)}{2f \times \left\{ I_{CL} - \frac{I_{LOAD}}{(1-D)} \right\}}$$

(7.4) Board Layout Considerations

High frequency switching regulators require very careful layout of key components in order to get stable operation and low noise. A good PCB layout could make AME5140 working perfect to achieve the best performance.

(7.5) PCB Layout Example

The PCB layout example is for standard step-up converter application with AME5140 device. It proves this EV board can achieve reliable performance. It follows the layout guidelines below.

(7.5.1) Use a ground plane under the switching regulator can effectively minimize inter-plane coupling.

(7.5.2) Using 20mil wide track for GND (as wide as possible), and all GND nodes are as close as possible.

(7.5.3) The SW node, schottky diode D1 and output capacitor Cout1 and Cout2 signal path should be kept extremely short.

(7.5.4) The feedback components R1, R2, R3 and C1 must be kept close to the FB pin of U1 to prevent noise injection on the FB pin trace and keeping far away from SW node.

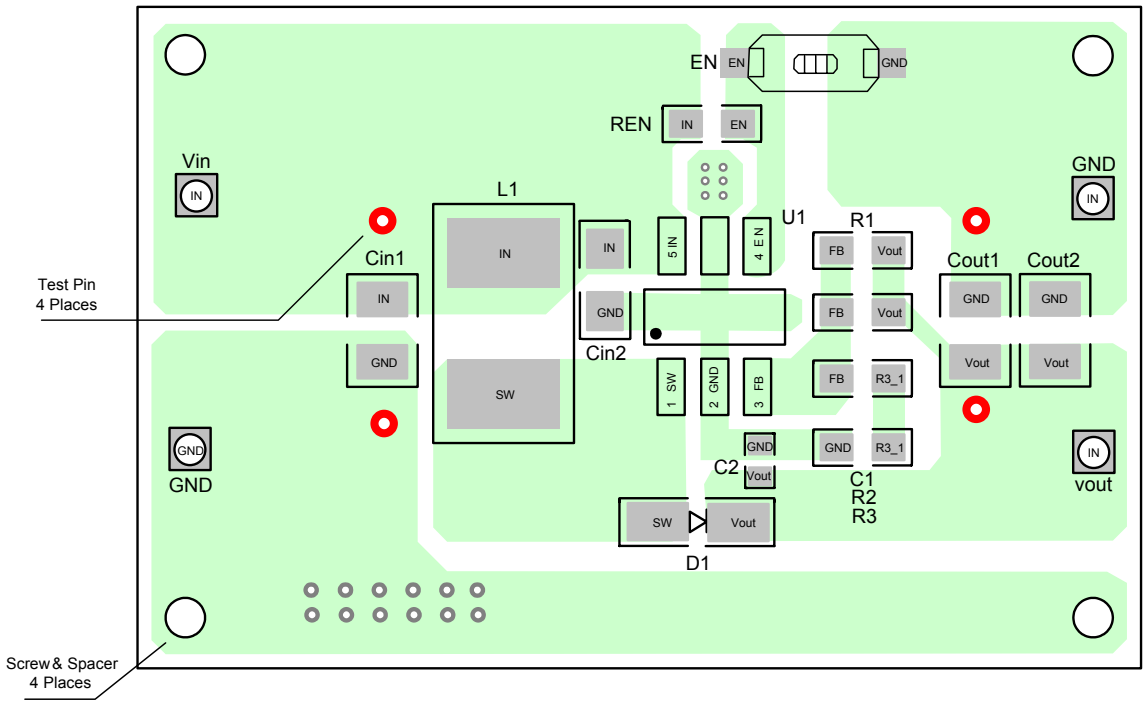

Figure 3

(7.6) Freewheeling Diode Selection

The freewheeling diode conduction time is longer than the N-channel Power MOS off time. Therefore, the diode parameters improve the overall efficiency. Using schottky diodes as freewheeling rectifiers reduces diode reverse recovery time and the voltage drop across the diode is lower. For this design, choice RB550SS-30, with 30V reverse voltage, 0.5A forward current, and around 0.5V forward voltage drop.

The freewheeling diode should be place close to the SW pin of the AME5140 to minimize noise coupling due to trace inductance.